Quantifying the GHG Benefits of Compost: Sampling Results in CA

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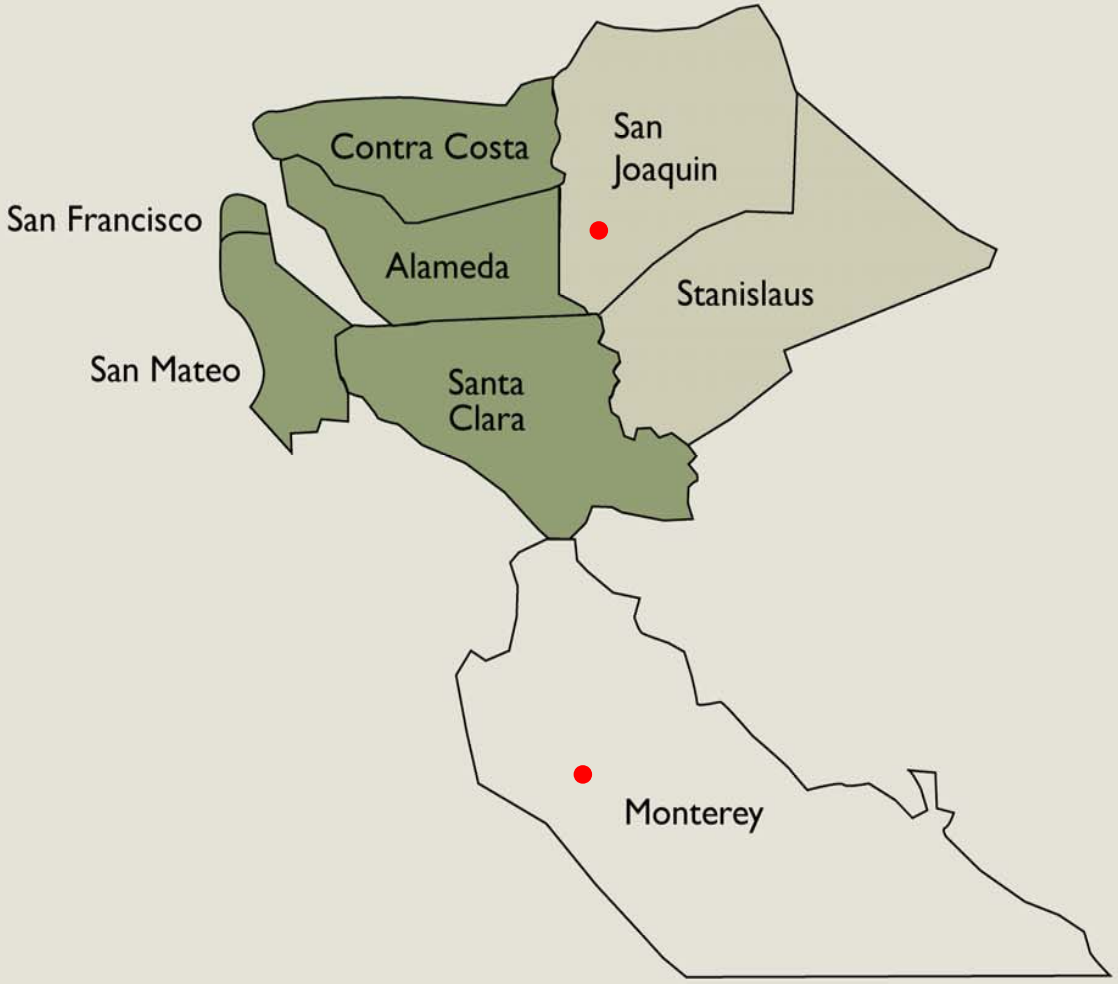
Organics Diversion

Goal of sampling- Project Design

- Identify composters within the Study Regions
- Identify associated growers with history of compost use
- Sample fields with and without compost applications
- Conduct lab analyses of Soil Samples

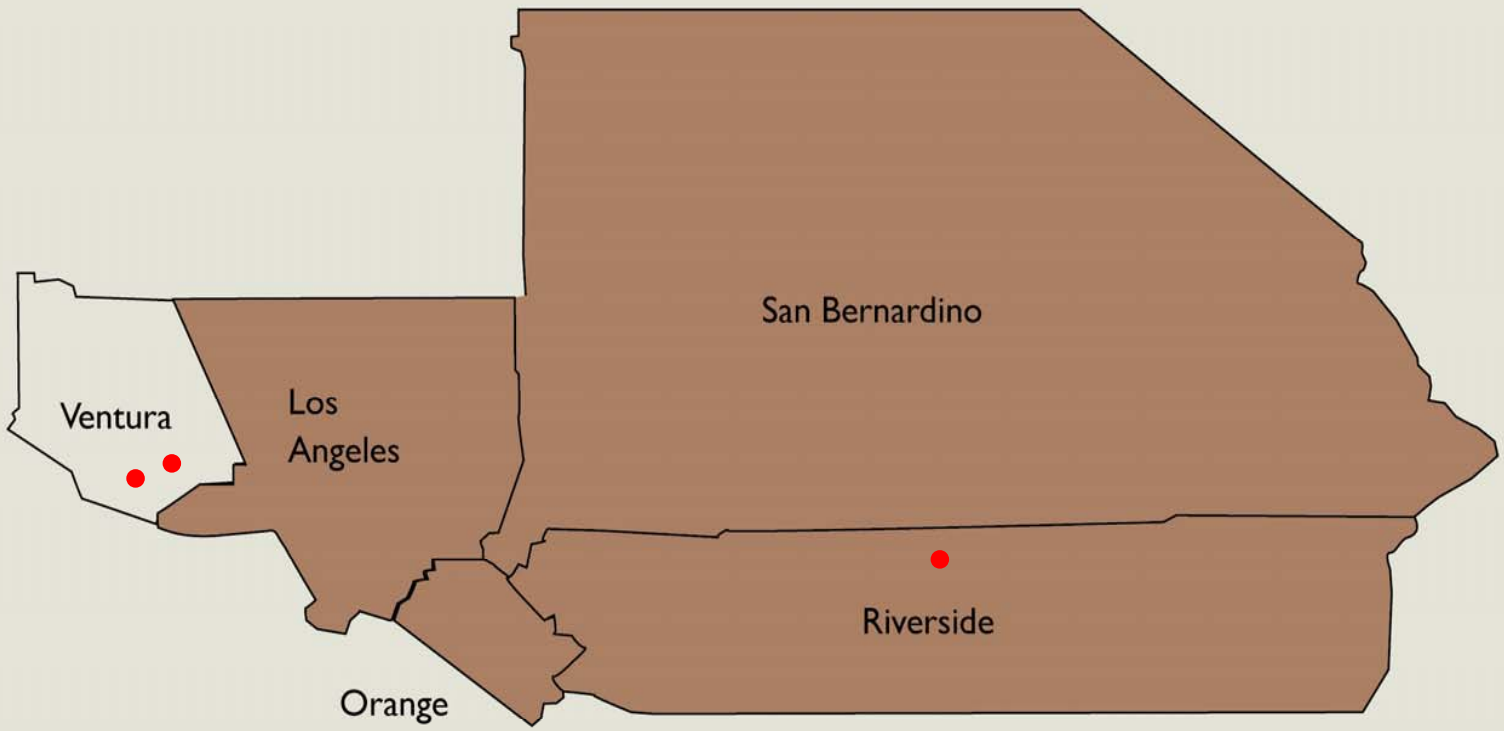
LCA Study Regions

Sample Locations - Southern Bay Area



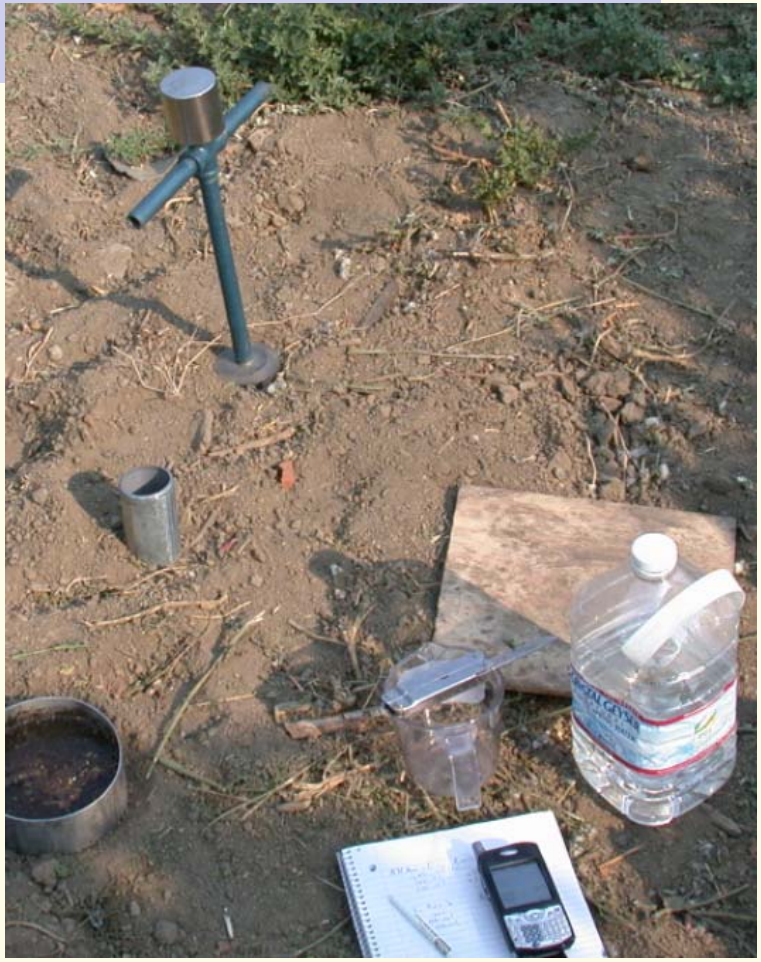
Sample Locations- Southern Central Valley

Sample Locations- Greater Los Angeles



Soil sampling

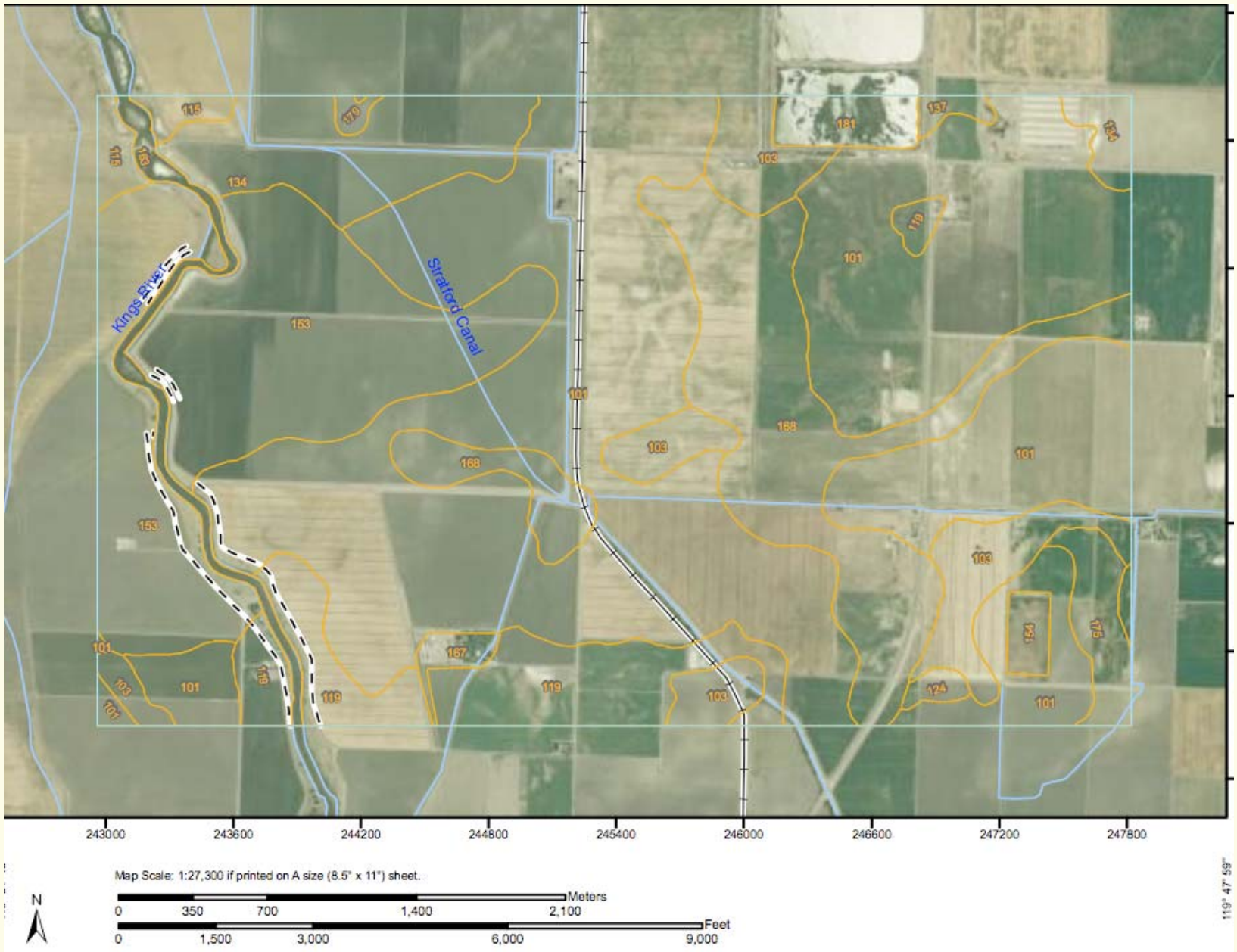
- Compost amended/control
  - 2-3 complete sets of samples per site per treatment
  - Composite of 4+ cores for chemical analysis
  - Water infiltration 2 runs per sample site
  - Bulk density, intact core



Control soils

- Soils were collected from directly under trees (treated) and from work rows (control)(6 sites)
- In some cases treated and control were collected from under trees/ cropped areas (3 sites)
- In case where control was different soil series, excluded from statistical analysis (1 site)

Soil variability



Soil Control Labs- Soil Analysis

- Organic carbon
- Microbial Activity
  - (CO_2 on incubated soils)
- Water Holding Capacity
  - (at 1 barr pressure)
- Bulk Density (g cm^3)
- Nutrient Availability
  - (Mehlich III, total N)
- Soil texture
  - (sieve analysis)

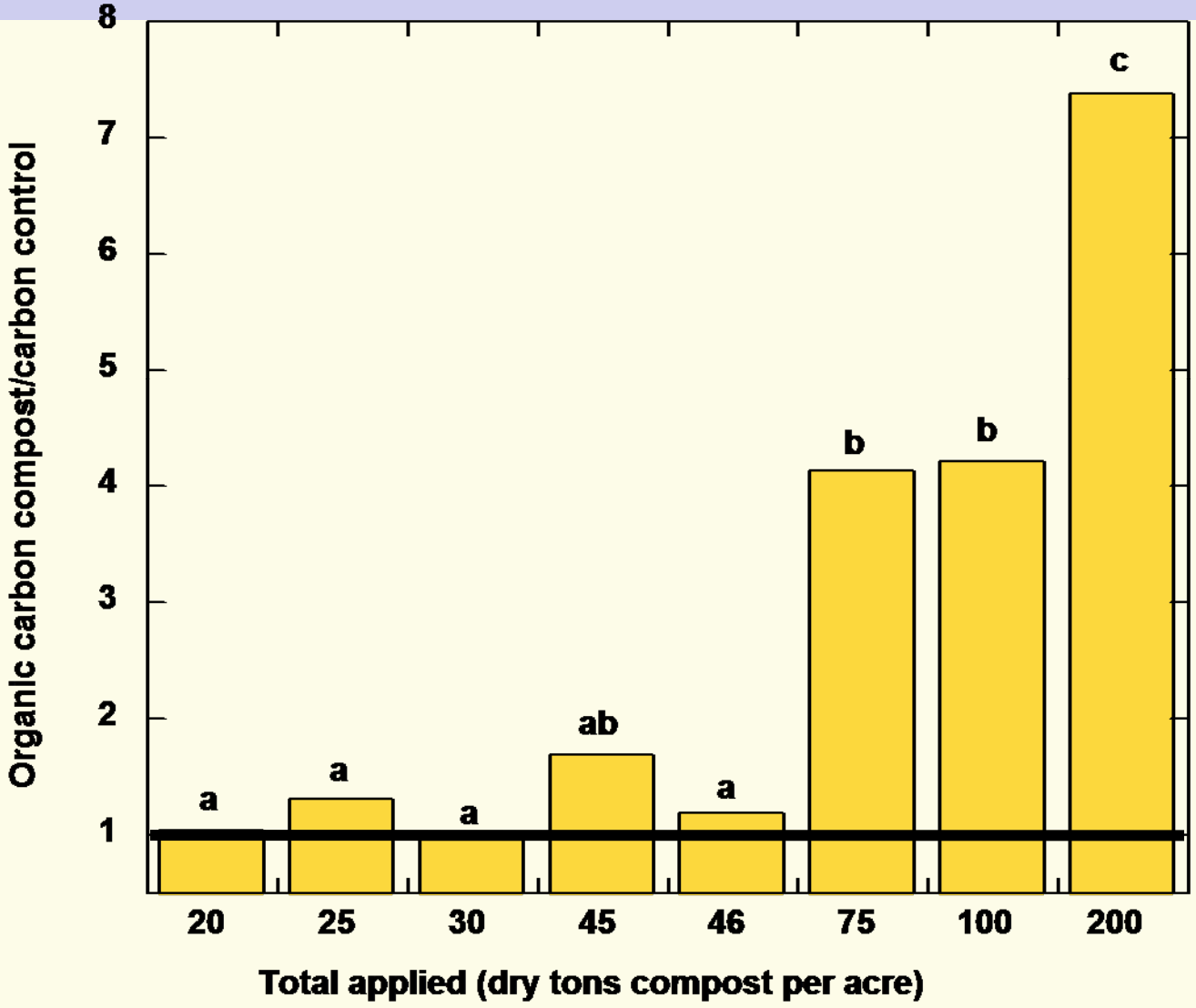
Data analysis

- SPSS used for statistical analysis
- Ratio variable developed to normalize results across different sites
  - Response in treated relative to control
- Significance used $p > 0.05$
- Sites with control in same soil series used for analysis

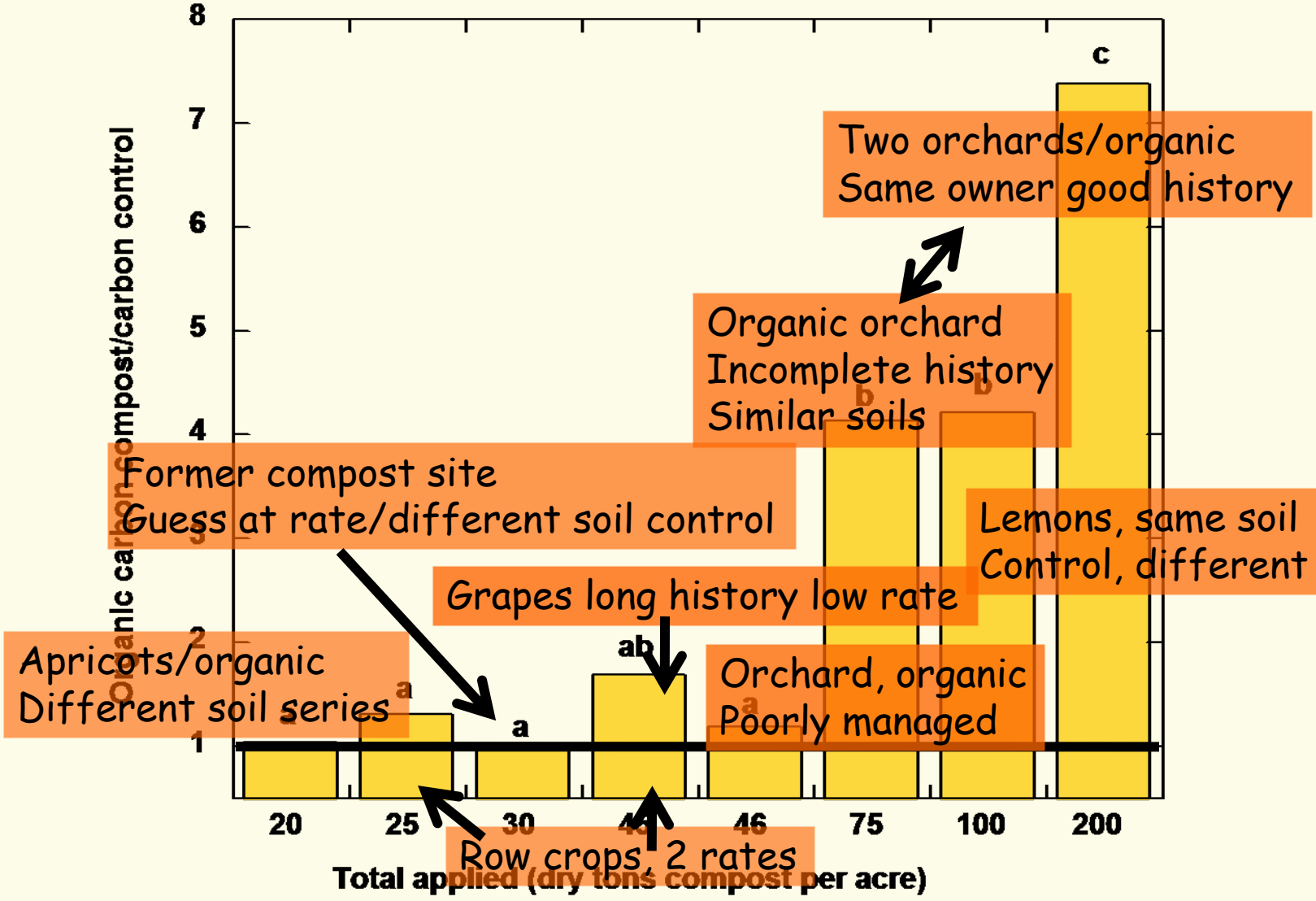
Change as a function of rate

- Tendency for greater impact at higher application rate
  - May be complicated by nature of sampling and distribution of sites
- Problems with rate x time
  - Some farmers have been applying low rates for a long time
  - Others high rates shorter time
  - Not precise quantities

Organic carbon- effect of rate



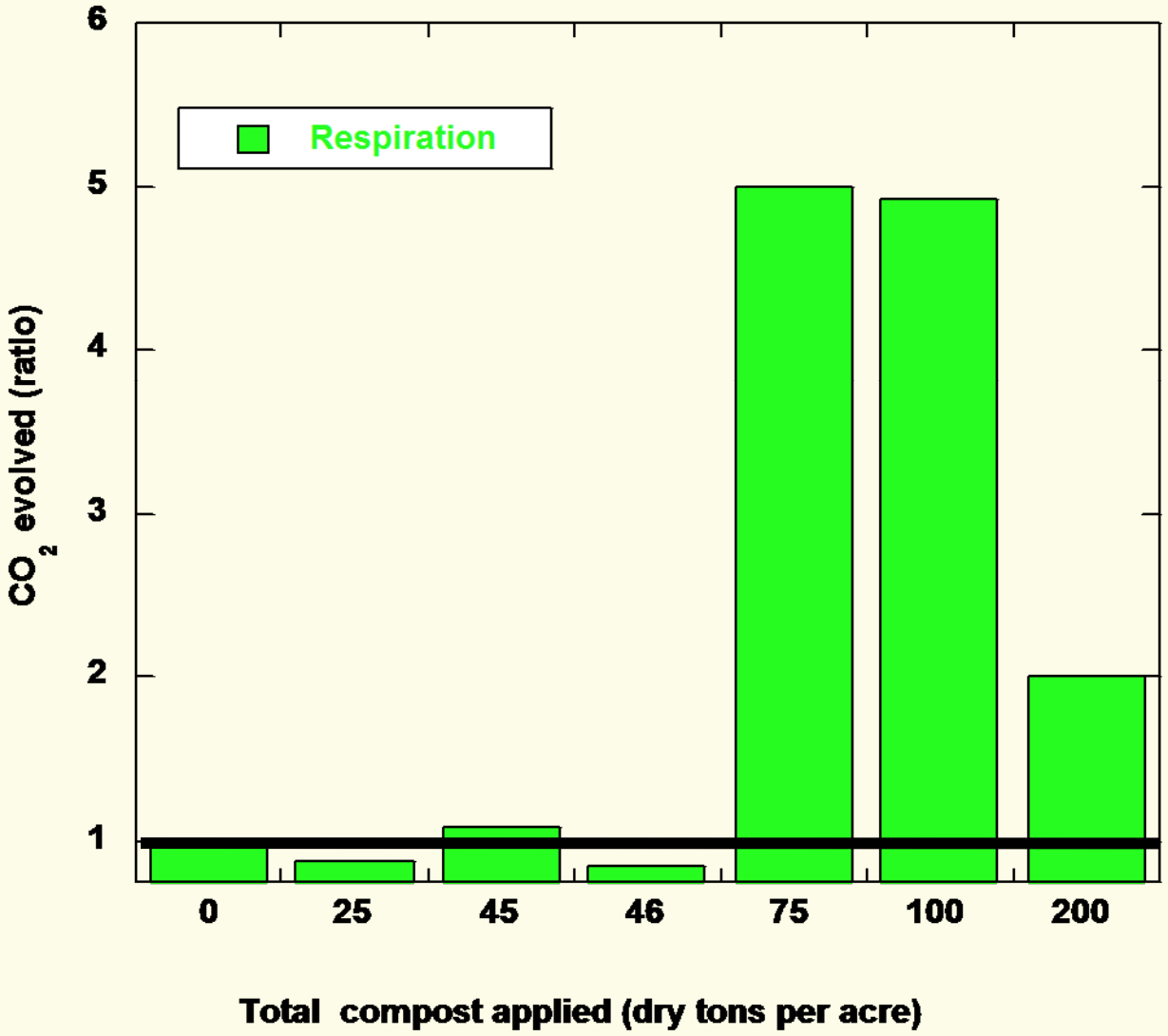
Organic carbon- Site variability



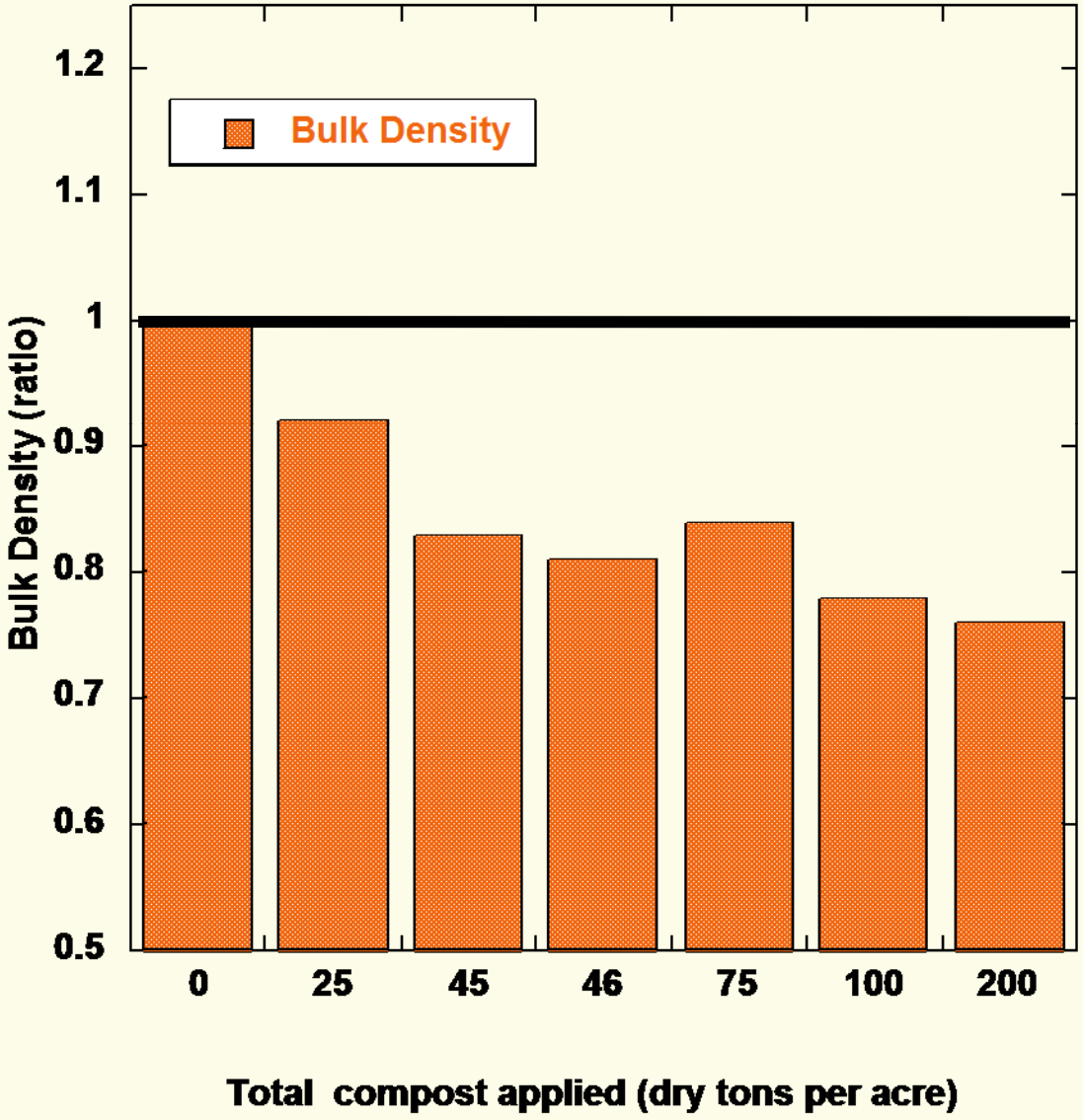
Function of sampling

- 0-15, 15-30 cm depths
- Surface applied compost
  - 0-7.5, 7.5-15
- Additional replication desirable
- Cross farm variability

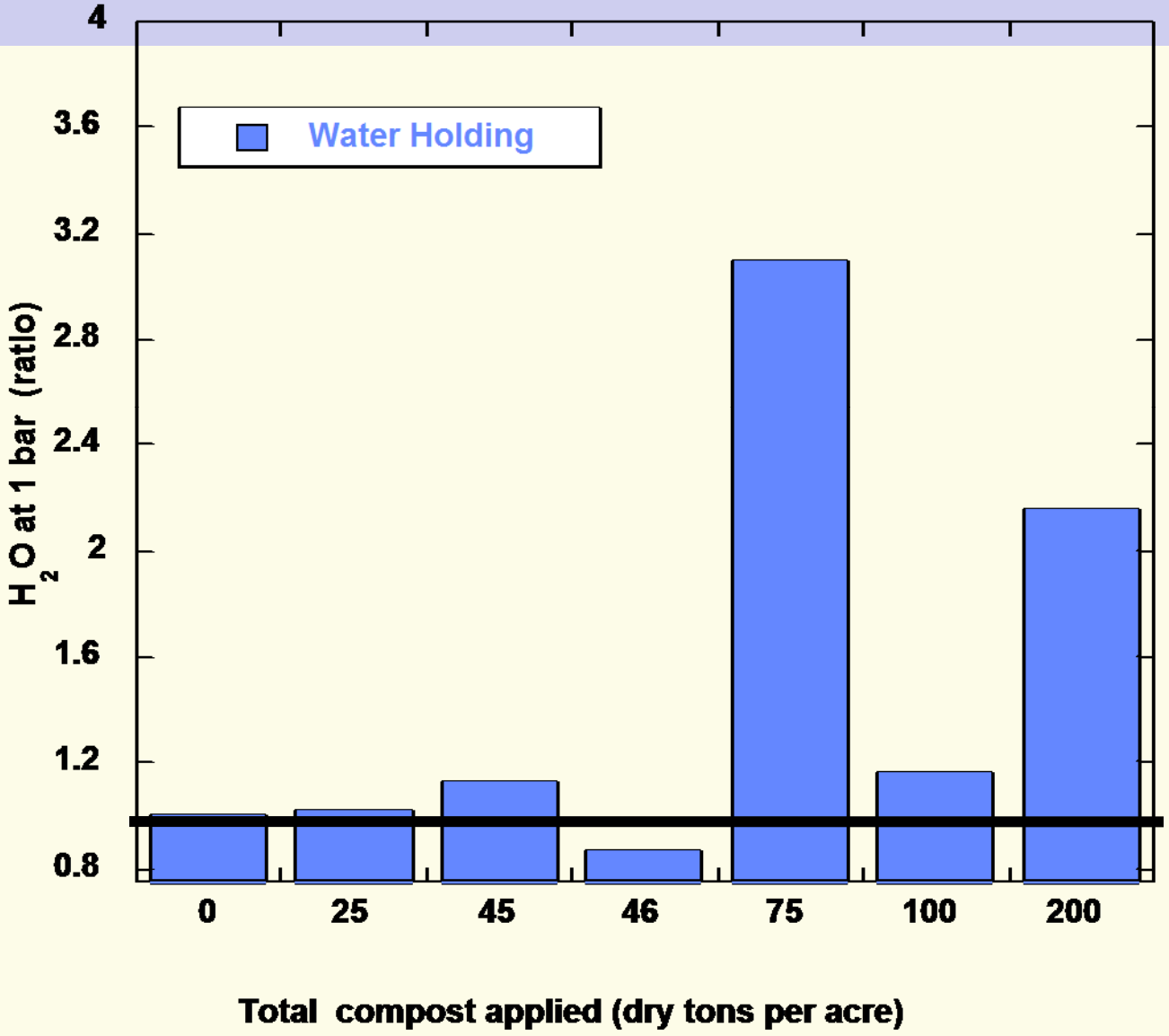
Microbial respiration- effect of rate



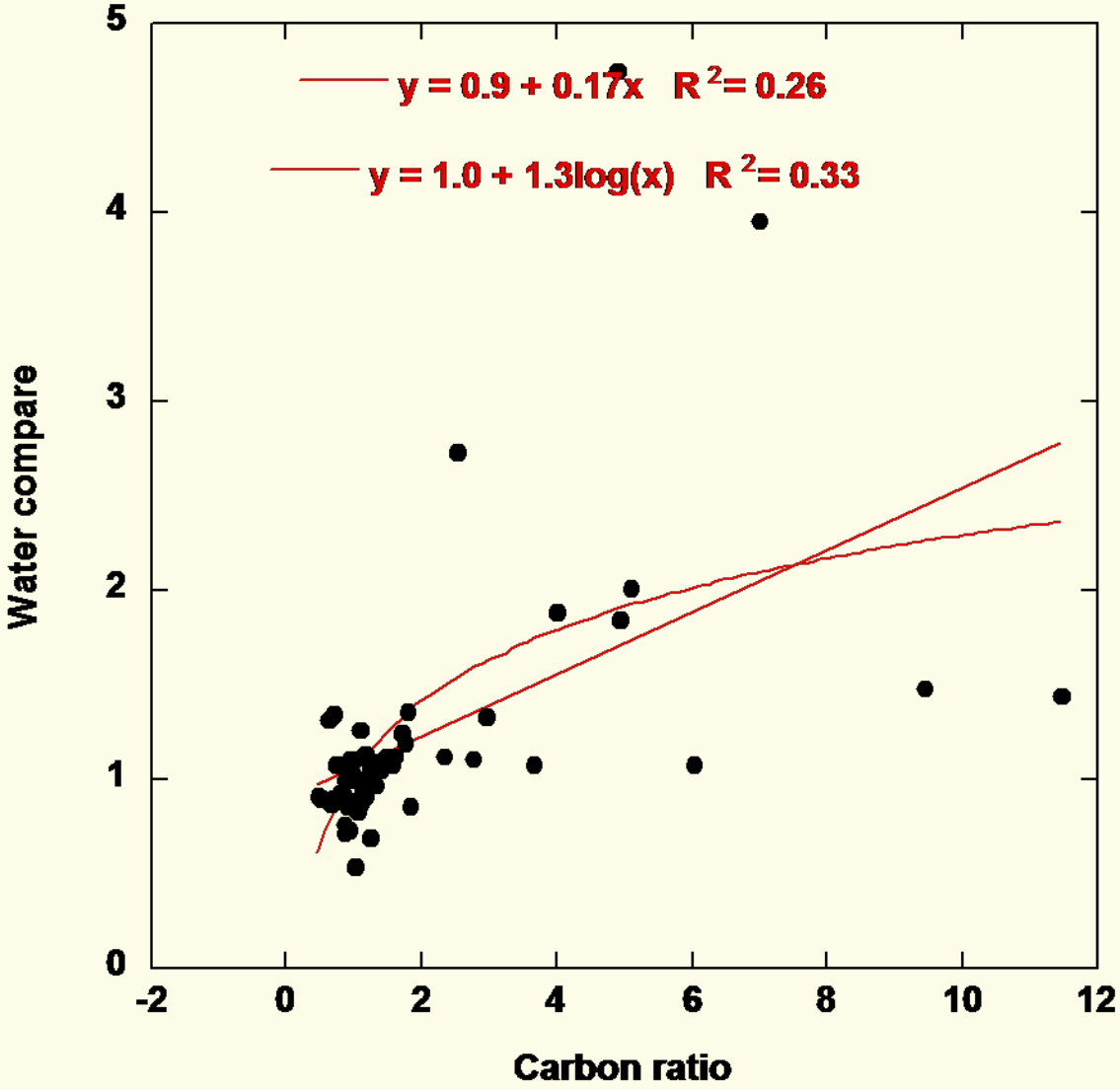
Bulk density- clearer trend



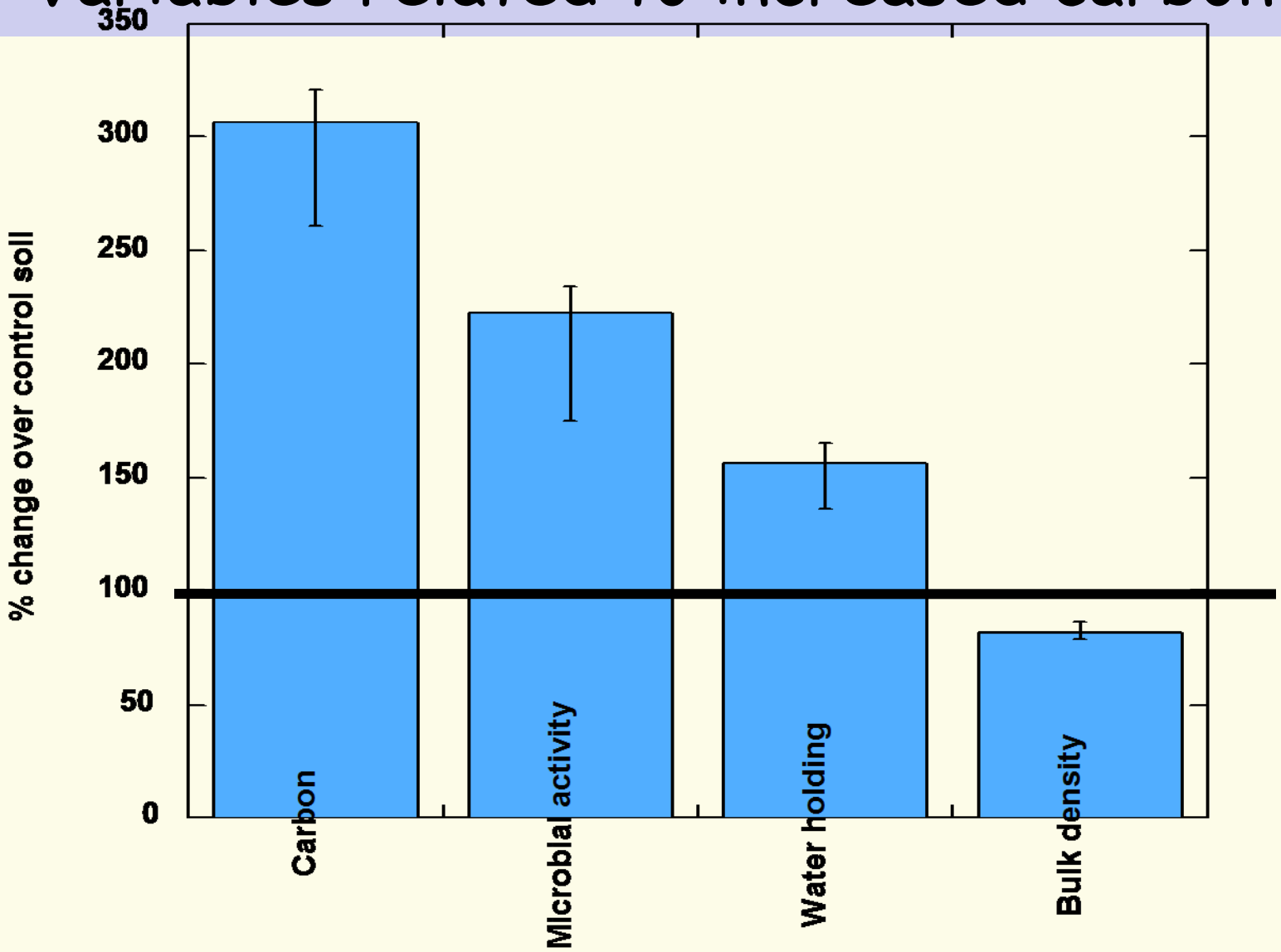
Water holding capacity- effect of rate



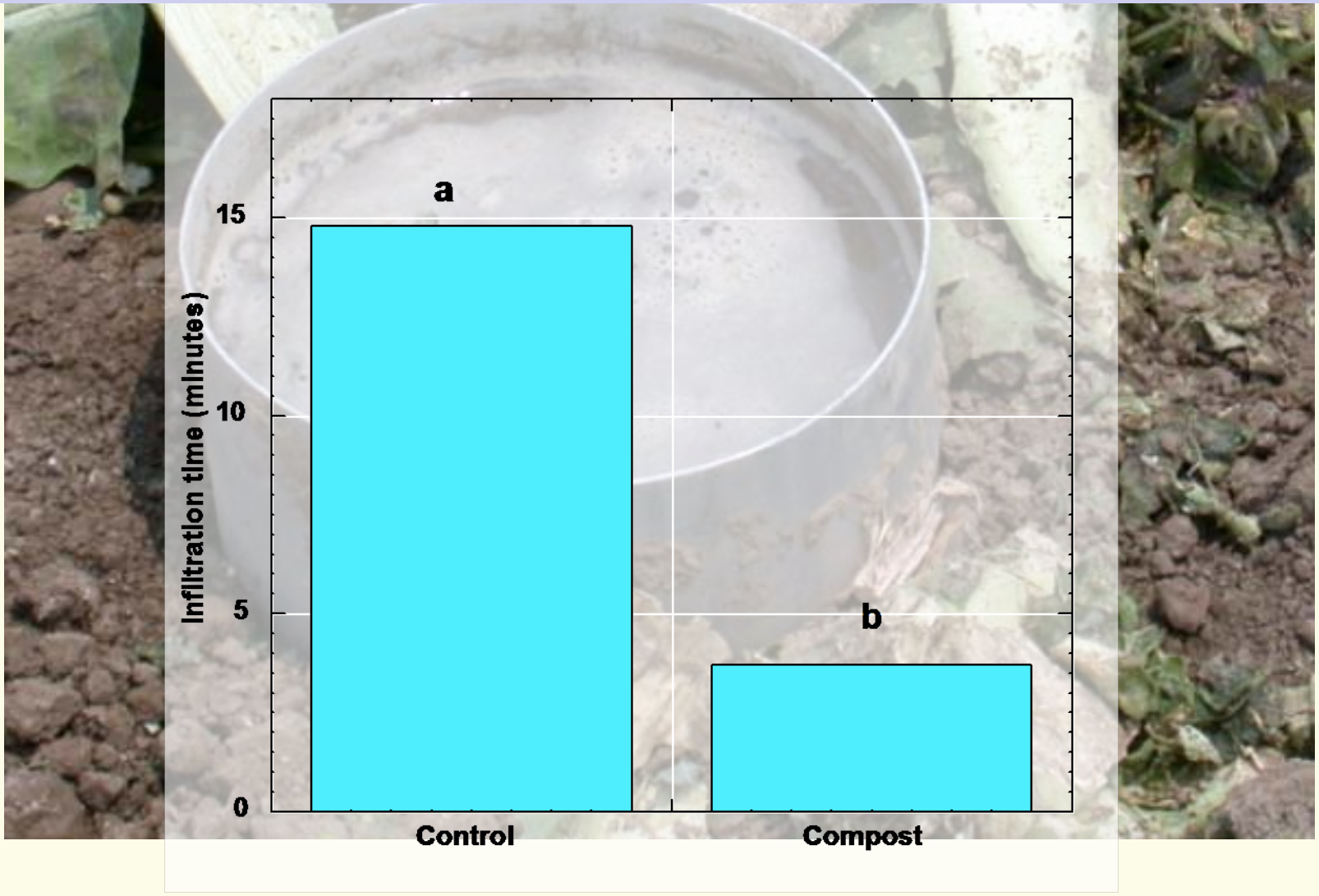
Carbon, water related- texture likely a factor



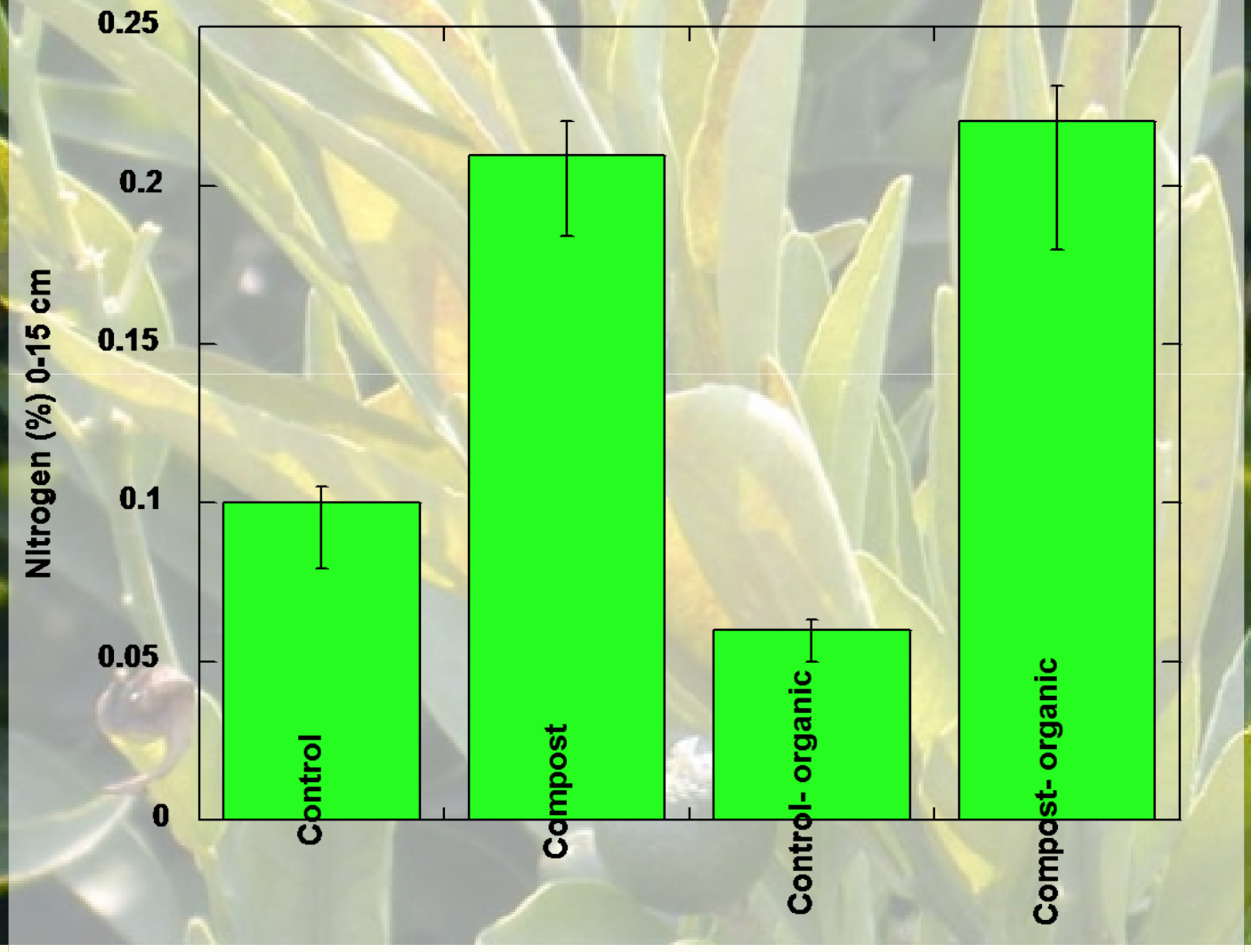
Across all sites (compost) Variables related to increased carbon



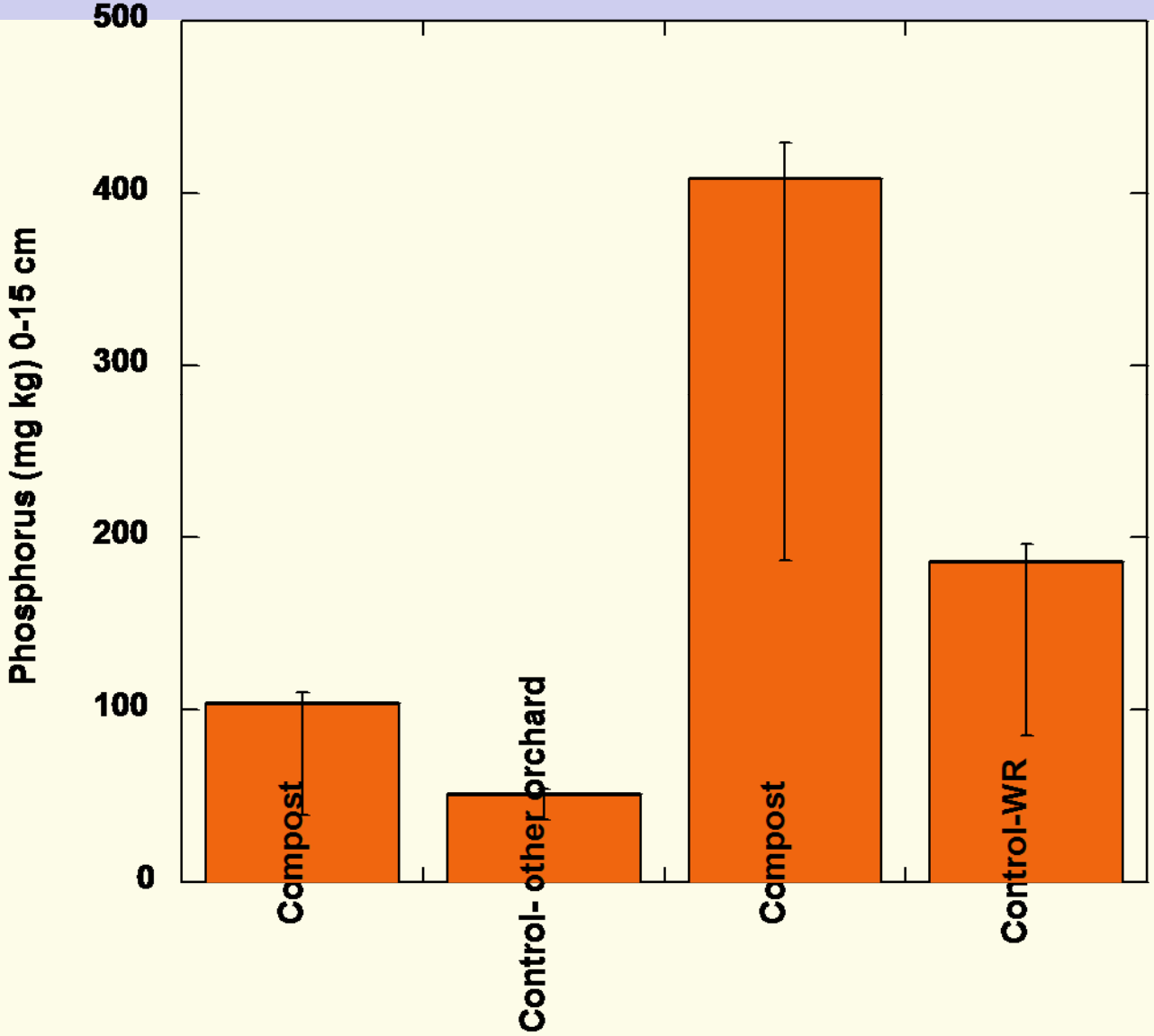
Across all sites (compost) Water infiltration



Total Nitrogen



Available Phosphorus



Specific sites- used to provide quantitative difference

Organic orchards
Riverside 20 x 10

Conventional orchard
Ventura
mulch
Single app, two sites

Tilled, organic conventional, control, two rates, Monterey

Organic orchard- fine sand soil 200 t/a over 10 year period Riverside, CA

	Total N	Organic Carbon	Bulk Density	H_2O per 100g	Infiltration rate
		%	g cm^3	mls	minutes
Control	0.04+- 0.007	0.37+- 0.1	1.5+- 0.2	9.6+- 0.6	3.3+- 0.3
Compost	0.28+- 0.04	2.7+- 0.4	1.1 +- 0.1	21.3+- 3.7	4.1+- 0.9
% change	700	730	-27%	225	24% longer

Organic row crops- fine sandy loam 45 t/a 5+ years period Monterey

	Total N	Organic Carbon	Bulk Density	H_2O per 100g	Infiltration rate
	%		g cm^3	mls	minutes
Control	0.08	0.7+- 0.02	1.7+- 0.1	25+- 0.08	18+- 17
Compost	0.1+- 0.002	1.1+- 0.05	1.3+- 0.08	29+- 0.6	0.67+- 0.1
% change	125	157	-24%	116	4% as long

Orchard crop- loam 125 t/a single mulch application period Ventura

	Total N	Organic Carbon	Bulk Density	H_2O per 100g	Infiltration rate
	%		g cm^3	mls	minutes
Control	0.2 +- 0.07	2 3+- 0.9	1.3+- 0.1	32+- 2.5	24+- 2.9
Mulch	0.2+- 0.04	2.1+- 0.6	1.1+- 0.4	38+- 1	0.9+- 0.6
% change	no change	-9%	-15%	119%	4% as long

University of New South Wales Recycled Organics Unit

(http://www.recycledorganics.com/publications/reports/)

- Modeled compost use as mulch for vineyards or soil conditioner for cotton
- Used existing literature as a basis for deriving benefits associated with compost use
- Used results as basis for comparison to our results

Carbon/ Water efficiency

	ROU	CA tilled	CA-surface	CA- mulch	Recommended Default
Organic carbon	256	291	382	0	256 kg CO_2 for tilled sites, 300-325 for no till or orchard sites
Water efficiency (% increase)	0.125	1.1	0.5	0.44	0.125

Fertilizer/Soil Structure

	ROU	CA tilled	CA- surface	CA- mulch	Recommended Default
		per dry Mg compost (unless otherwise specified)			
Fertilizer (kg CO_2 eq)	**11.8-31.3**		**56**	**0**	**56- based on NPK of 9, 9.5 and 10 kg per Mg Use specific compost analysis when possible**
Soil structure- bulk density (% decrease)	**2% decrease per 12 Mg compost for incorporated**	**2.9% decrease per 12 Mg**	**0.7% decrease per 12 Mg**	**0.7% decrease per 12 Mg**	**2% per 12 Mg incorporated, 0.5% per 12 Mg for surface application**

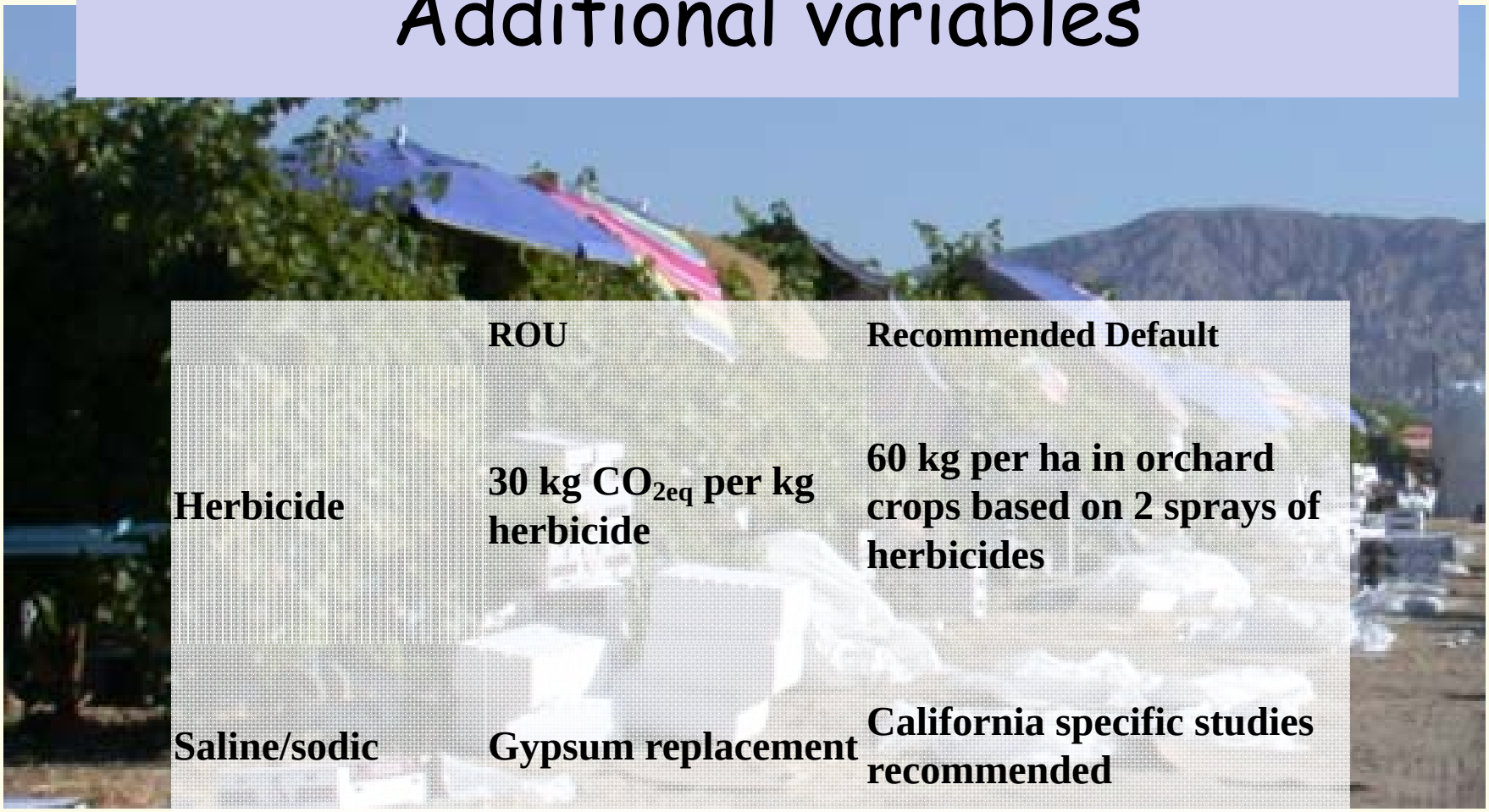
Soil Tilth

	ROU	CA tilled	CA- surface	CA- mulch	Recommended Default
		per dry Mg compost (unless otherwise specified)			
Soil Tilth- using carbon and microbial activity as indicators	degradation of soils has a cost of $4484 per ha	146% increase in CO_2 emissions/ increase in carbon from 0.7 to 1.1%	Overall 33% increase in CO_2 emissions/ overall increase in carbon from 0.7% to 1.27%	164% increase in CO_2 emissions/ no increase in soil carbon	Value set by ROU/2 Conservative default $2000 per ha

Soil Erosion

	ROU	CA tilled	CA- surface	CA- mulch	Recommended Default
Erosion	1.2% reduction in tilled crops, complete reduction for mulch applications	Infiltration rate 4% as long as control	Infiltration rate 24% longer than control- results specific to this site	Infiltration rate 4% as long as control	We saw an overall average decrease in water infiltration rate of 33% across all sites that received compost or mulch. This can be used as an indicator of reduced erosion potential. Use ROU default values

Additional variables

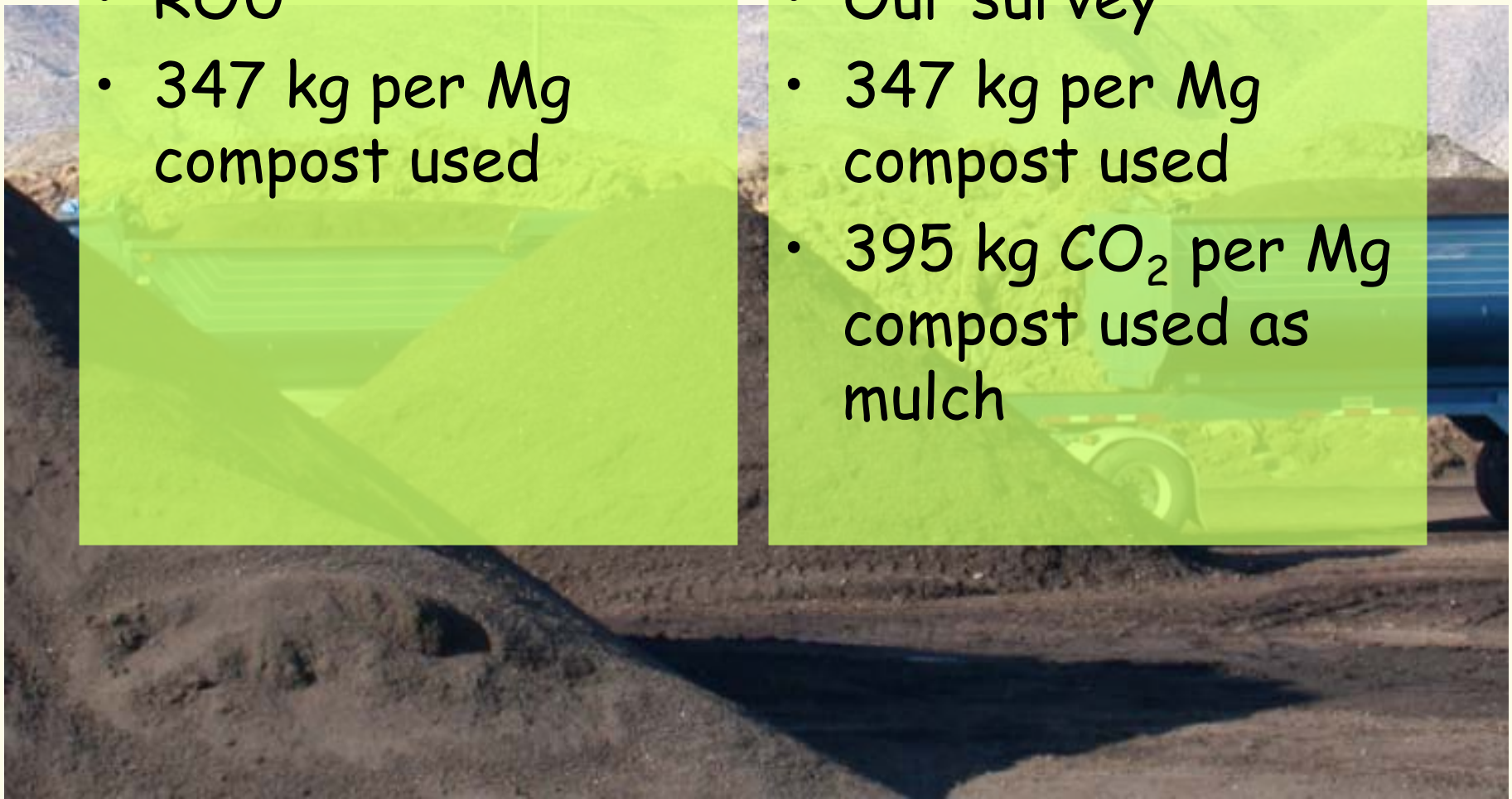


	ROU	Recommended Default
Herbicide	**30 kg CO_{2eq} per kg herbicide**	**60 kg per ha in orchard crops based on 2 sprays of herbicides**
Saline/sodic	**Gypsum replacement**	**California specific studies recommended**
Plant yield	**1-2% yield increase per Mg compost**	**1-2% yield increase per Mg compost**

GHG per Mg Compost used

- ROU
- 347 kg per Mg compost used

- Our survey
- 347 kg per Mg compost used
- 395 kg CO_2 per Mg compost used as mulch



Conclusions- GHG

- Using CCX values- one dry Mg of food waste diverted from landfill = 3 Mg CO_{2eq}
- Assuming 80% decomposition, each Mg of food waste = 0.1 Mg CO_{2eq}

Acknowledgements

John Beerman, California Bio-Mass	Richard Crockett, Burrtech Industries
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Peter Reece, Ratto Brothers	Kim Carrier, Jepson Prairie Organics
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